Get a blank Periodic Table, colored pencils, crayons, markers, etc. and identify the following locations. Use the Periodic Tables in the classroom, chemistry books in the front of the room and/or the computers to help you with this assignment.

Groups and families are the columns

Series and periods are the rows

Groups 1 to 18

Groups IA to VIIIA

Groups IB to VIIIB

Periods 1 to 7

Lanthanide series

Actinide series

Alkali metals(sodium family)

Alkaline earth metals(calcium family)

Transition metals(transitional elements)

Boron family

Carbon family

Nitrogen family

Oxygen family(chalcogens)

Halogens

Noble gases(inert gases)

Rare earth elements

Inner transitional elements

Zig zag line that separates the metals and the nonmetals

Where are the metals vs nonmetals vs metalloids located?

Which element that touches the zig zag line is really a metal not a metalloid?

Where are the solids, liquids, and gases located?

What are the two liquids on the periodic table? Put their symbols in the correct box.

Where are the twelve gases. Put their symbols in the correct box.

Where are the s, p, d, and f blocks on the periodic table. What do they represent?

Characteristics of the Periodic Table

Group IA-alkali metals, sodium family

Hydrogen- diatomic gas, H2 , colorless, odorless, very light

Used in the Hindenburg disaster, rocket fuel

Later used He since it also is light but unreactive

Li, Na, K, Rb, Cs, Fr

Light metals, shinny, very soft metals that can be cut with a knife

React violently with air and water

(least reactive) Li, Na, K, Rb, Cs, Fr (most reactive) The reactivity of METALS increases as you go down a group.

Ex: Drano

2 Na + 2H2O  2NaOH + H2

strong

base

Group IIA- alkaline earth metals, calcium family

Be, Mg, Ca, Sr, Ba, Ra

Light metals, shinny, soft metals but not as soft as group IA.

Reacts with air and water but not as violently as group IA.

Ex: Limestone

CaO + H2O  Ca(OH)2 Put on grass as fertilizer but if you put too much on it will

Base burn the grass.

Group VIIA- The halogens

F, Cl, Br, I, At

Diatomics: F2, Cl2, Br2, I2

The only group on the periodic table that has representatives of all states of matter at room temperature. Gases (F, Cl) Liquid (Br) Solids (I, At)

Colors become more intense as you go down the group.

(most reactive) F, Cl, Br, I, At (least reactive) The reactivity on NONMETALS decreases as you go down a group.

Group VIIIA- Noble gases, Inert gases

He, Ne, Ar, Kr, Xe, Rn

Outer energy level has 8 valence electrons. This is known as a full **octet.**

Sir William Ramsey is given credit for discovering these elements.

They are inert(unreactive)

They are used for advertising lights, neon lights.

Element Lab

Name& Isotope Atomic Proton Neutron Electron Metal Color Solid, Group

Symbol Mass Number Nonmetal Liquid, Name

Metalloid or Gas

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C |  |  |  |  |  |  |  |  |  |
| C |  |  |  |  |  |  |  |  |  |
| Ne |  |  |  |  |  |  |  |  |  |
| Na |  |  |  |  |  |  |  |  |  |
| Mg |  |  |  |  |  |  |  |  |  |
| Al |  |  |  |  |  |  |  |  |  |
| Si |  |  |  |  |  |  |  |  |  |
| P |  |  |  |  |  |  |  |  |  |
| S |  |  |  |  |  |  |  |  |  |
| S |  |  |  |  |  |  |  |  |  |
| Ca |  |  |  |  |  |  |  |  |  |
| Cr |  |  |  |  |  |  |  |  |  |
| Fe |  |  |  |  |  |  |  |  |  |

Element Lab Cont’d

Name& Isotope Atomic Proton Neutron Electron Metal Color Solid, Group

Symbol Mass Number Nonmetal Liquid, Name

Metalloid or Gas

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ni |  |  |  |  |  |  |  |  |  |
| Cu |  |  |  |  |  |  |  |  |  |
| Zn |  |  |  |  |  |  |  |  |  |
| Ru |  |  |  |  |  |  |  |  |  |
| Ag |  |  |  |  |  |  |  |  |  |
| Cd |  |  |  |  |  |  |  |  |  |
| Sn |  |  |  |  |  |  |  |  |  |
| Sb |  |  |  |  |  |  |  |  |  |
| I |  |  |  |  |  |  |  |  |  |
| Pt |  |  |  |  |  |  |  |  |  |
| Pb |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

Periodic Law Lab

**The Periodic Law**

The present organization of the elements is a product of the first periodic table published by Dmitri Mendeleev (1834-1907) in 1869. The amazing accuracy of his predictions has been very important to the chemists in this century. However, the basis of his arrangement was the atomic masses of the elements. This approach proved incorrect, as it would have placed some elements in the same family with dissimilar properties. Henry Moseley, in 1913, rearranged the table on the basis of the atomic number of the elements. In accordance with Moseley revision, the **periodic law** states: ***the properties of the elements are periodic functions of their atomic number.***

Each of the 106 known elements has its own set of characteristics properties. These range from solid to gas, lusterous to dull, low to high melting points, various colors, and so on. The elements are arranged within the periodic table in groups or families {vertical columns} and periods or rows {horizontal rows}. This arrangement reflects the periodic or **repeating nature of the properties of the elements**.

In this experiment, you will use your knowledge of the periodic properties and a list of clues to correctly arrange the elements from a scrambled periodic table. You will also predict values for any information missing from the table.

**Objective:**

1. Arrange the elements in groups 1A-VIIIA according to a list of clues and yor knowledge of the periodic properties

2. Predict the missing properties of each element based on the location in the table; and, Explain the trends of the properties in the families and periods.

**Procedure**

1. Locate table- 17-1 and cut out blocks A-Z.
2. Use the following clues and arrange the elements in their proper order on the table 17-2. When you have placed them in their correct position; glue them to the table 17-2.

**3)** Cut out the remaining unknown blocks and use information provided to place in blank spots in the 5th and 6th periods.

**CLUES**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The following sets of elements belong together in families: ***ZRD, PSIF, JXBE, LHT, QKA, WOV, GUN, YMC.***

J has an atomic number three times that of T and is a noble gas.

U has a total of six electrons.

I2A is the simple formula of an oxide.

P is less dense then S.

S is an alkali metal.

R is a metal with an oxidation no. of +3

A is on the 2nd period in the oxygen family.

G is a semi-metal

O is used to clean pools

E is a noble gas

W is a liquid, non metal

Z is a semi metal on the 2nd period

T is an alkaline metal on period 3.

B has ten protons, and glows red.

O has an atomic number larger than V

V has a-1 valence shell

D has 3+ and is a metal. It also has an atomic mass that is the largest of its set.

C has five electrons in its outer energy

level and is on the 3rd period.

F is a gas, and is extremely flammable.

X has and atomic number one higher then F.

L is and alkaline earth element with atomic mass of 40, and reacts with water.

Y is a metalloid that can kill you if ingested.

V is the most reactive halogen

The atomic mass of T is more than that of H.

Q has an atomic mass 2 times that of A.

Atoms of I are larger than those of S.

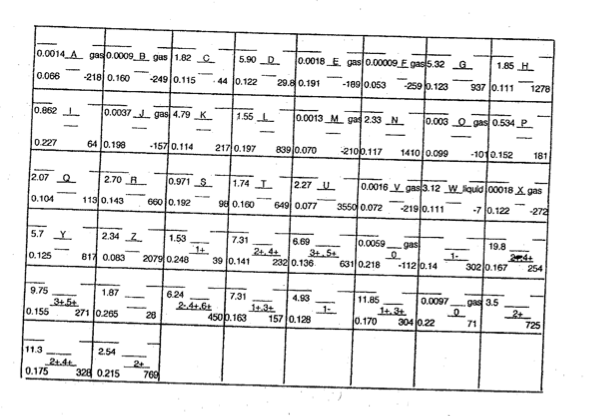
M has an atomic number one less than that of A and is in the Nitrogen Family.

The electrons of atom N are distributed over three energy levels, and is a semi metal.

The atomic radius of K is the largest of the set.

IA VIIIA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | IIA | IIIA | IVA | VA | VIA | VIIA |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |



Properties of Metals and Nonmetals

metals nonmetals

Location on the PT left of zigzag right of zigzag

a. ionization energy low high

b. electronegativity low high

c. luster high low

d. deformability malleable and ductile brittle

e. conductivity of heat and electricity good poor

f. phase at ordinary conditions solid except for\_\_\_\_ gas or solid except

for\_\_\_\_\_

g. ion formation lose electrons to form gain electrons to

positive ions form negative ions

h. melting point high low

i. boiling point high low

j. metallic behavior high due to few e-’s in low due to many e-’s

highest energy level in highest energy

and are able to lose and want to gain e-’s

them easily NOT lose e-’s

Trends Groups Periods

a. reactivity increases for metals on left side of PT increases for periods 1,2,3

decreases for nonmetals on right side decreases for periods 5,6,7

b. atomic number increases increases

c. atomic mass increases increases generally

d. density increases increases(metals) then decreases(nonmetals)

note: metals have greater density than nonmetals generally. Those with the greatest density are in periods 6 and 7, of the transitional metals and groups IIIA to VIA

e. melting point(metals) decrease slightly then level off increase slightly then

decrease(due to the change

from metals to nonmetals)

f. boiling point(metals) “ “

g. melting point(nonmetals) “ “

h. boiling point(nonmetals) “ “

note: for periods, the MP/ BP is high and continues to increase as long as it is a metal/ metalloid but then decreases once it is a nonmetal and then continues to decrease.

for period 2, the MP/ BP is higher than the other periods due to the e-’s being closer to the nucleus and it taking more energy to change the phase.

i. metallic behavior increases due to e-’s being decreases due to changing

farther from the nucleus from metals to nonmetals

j. atomic radii(half the increases due to more decreases due to more energy level

distance from two nuclei attraction between e-’s and

of a covalent bond) protons since there are

more e-’s and protons

k. electronegativity decreases due to valence e-’s increased desire to gain e-

(attraction for shared e-’s being further away from nucleus since it will be closer to

in a bond. How bad does and a full octet still won’t occur having a full octet

it want an e-’s?) (except for group VIIA)

note: as electronegativity values decrease, metallic behavior increases due to NOT desiring an e-. it would rather get rid of an e-.

l. ionization energy(energy decreases due to e-’s being increased energy needed

needed to remove an e- further from the nucleus and to remove e- since e-’s are

from a gaseous atom/ ion) being easier to get rid of closer to nucleus and close to a full octet.

m. electron affinity(energy constant with a slight increase irratic -high values for non-

needed for a gaseous metals-low(+)value or(-)value metals(except VIIIA) and

atom/ ion to acquire an e- they don’t want to gain e-’s they low/ negative values for

and form a negative ion want to lose e-’s. group VIIIA(-) metals and group VIIIA

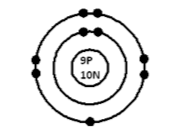
values and doesn’t want to gain it wants to gain an e- if it will

e-’s since it’s a full octet already be more stable(full/ half full)

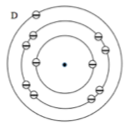
endothermic-energy absorbed exothermic-energy released

Octet rule- when forming a bond, the bond would like to have 8 valence electrons in its outer most energy level to be stable. Exception: H and He where it only needs 2 valence electrons in its outer most energy level to be stable.

For example, a fluorine-19 atom has 9 protons, 10 neutrons, and 9 electrons(2 in the first energy level and 7 in the second energy level). It has a HIGH electronegativity value because it wants one more electron to complete its outer energy level and have a full octet.



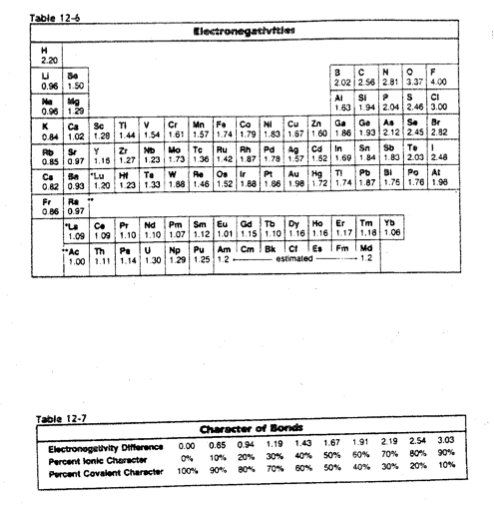
Where can it get an extra valence electron? Possibly, sodium. A sodium-23 atom has 11 protons, 12 neutrons, and 11 electrons(2 in the first energy level and 8 in the second energy level and 1 in the third energy level). It has a LOW first ionization energy value because it would like to lose and electron.

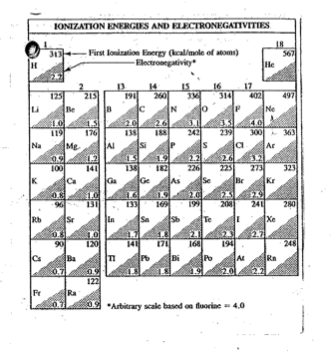


This is an example of an ionic bond. Electrons are transferred. This is common between metals and nonmetals.

When we have nonmetals that are bonding, this is known as a covalent bond(either polar or nonpolar) due to sharing of electrons to form a complete octet.

Example: One carbon-12 atom has 6 protons, 6 neutrons, and 6 electrons.(2 in the first energy level and 4 in the second energy level) Due to the octet rule, it would like 4 more valence electrons to have a full octet. Where could it get them from? How about bonding it with 4 hydrogen’s. Hydrogen has 1 valence electron in its first energy level. Let’s draw it!!!





Worksheet: Electronegativity, polar, nonpolar, and ionic bonds.

1. Arrange the following elements in order of increasing force of attraction between the nucleus and the electrons.

a. arsenic, gallium, germanium, radium, sulfur

b. aluminum, potassium, francium, nitrogen, iodine

2. Classify the bonds as polar, nonpolar, or ionic. Also include percentages.

a. boron-carbon f. beryllium-fluorine

b. cesium-fluorine g. bromine-strontium

c. fluorine-silicon h. chlorine-lithium

d. hydrogen-chlorine i. chlorine-sodium

e. magnesium-nitrogen j. hydrogen-iodine

3. Fill in the chart.

Bond Pair Electron Difference % ionic % covalent ionic/covalent polar/nonpolar/neither

a. sodium-

oxygen

b. hydrogen-

bromine

c. lead-

sulfur

d. carbon-

nitrogen

e. magnesium-

iodine

4. Know all definitions: ionic, covalent, polar, electronegativity, etc.

5. For each atom pair listed below, decide whether an ionic, polar, or nonpolar bond would form between the elements.

a. fluorine-astatine d. lanthanum-selenium

b. boron-thorium e. strontium-chlorine

c. gadolinium-astatine f. iodine-sodium

5. The following pairs of atoms are all covalently bonded. Arrange the pairs in order of decreasing polarity of the bond pairs.

a. boron-nitrogen d. iodine-technetium

b. carbon-sulfur e. nitrogen-oxygen

c. hydrogen-selenium f. aluminum-phosphorus

Worksheet: Periodic Trends: Atomic Radii, Ionization Energy, Electron Affinity

1. What is atomic radii?

2. Explain atomic radii’s periodicity. How does it change within groups and periods? Why?

3. Arrange the following elements in order of increasing atomic radii.

cesium, aluminum, calcium, potassium, sulfur, and oxygen

4. What is ionization energy?

5. Explain ionization energy’s periodicity. How does it change within groups and periods? Why?

6. State the long method orbital notation for the following. Then, state the 1st, 2nd, 3rd, and 4th electron that would be removed from that orbital notation. Keeping in mind the trends of ionization energy, state the amount of energy it would take to remove each electron----ionization difference between each successive electron (a little, medium, a lot). Include a justification for each electron.

1st: a lot due to a full energy

Ex: Ca (20 e-’s) [Ne]\_\_\_\_ \_\_\_ \_\_\_ \_\_\_\_ \_\_\_ level.

3s 3p 4s 2nd: a little due to its

4th 3rd 2nd1st removal will make a full

energy level

3rd:a lot due to a full energy

level.

4th: medium due to its

removal will not make a

full, or half full energy level.

a. C

b. Ge

c. Zr

d. Na

7. What is electron affinity?

8. Explain positive(high and low) and negative values of electron affinity. State how electron affinity varies within a group and period. Why?

9. What is exothermic? endothermic?